Abstract

India is the second populous country in the world with more than 70% of the population living in rural area, 60% of India’s 1.1 billion populations living off agriculture which contributes to 17% of the Indian economy. The main resource for the agriculture is timely and adequate supply of water and electricity. Nearly 20% of the farmers in India are dependent on electric water pumps for irrigation. However many states have a huge gap in demand and supply of electrical energy. The highly unreliable power supply with frequent power cuts has lowered the operational efficiency of farmers. In this paper, we have discussed an intelligent mobile based solution that has helped farmers to increase the operational efficiency. The methodology of the paper is based on case study where mobile solutions have been deployed which has resulted in benefits to all the stakeholders making it a sustainable deployment.

Keywords: Social benefits, mobile based solution, stakeholders benefits

1. Introduction

India is the largest democratic country with population to the tune of 1.03 billion. It is the second most populous country with more than 70% (NCAER, 2002) population in rural area. Almost 740 million live in villages which are scattered over the country. As per NCAER (2002) report, there are more than 635,000 villages in the country with no or poor infrastructure. However, output from this population, which Prahlad (2001) terms as bottom of pyramid, is only 25% of national GDP (NCAER, 2002) amounting to roughly US$ 140 billion. This is completely disproportionate as a handful of population contribute to the national wealth tilting the wealth balance towards the rich. This implies that more than 75% of the population earn less than US$ 500 per annum, meaning they earn less than US$ 2 per day as household income.

Rural India is largely illiterate, with literacy rate less than 50% (Department of education ministry, 2003), where as the literacy rate is higher at 70% for urban population. In rural area, many schools buildings are in dilapidated conditions and the ratio of teachers to students is at 1: 45, a totally lopsided figure. This results in not only inefficiency, but also in high drop out rates for school children. Many villages do not have schools and access to these villages by road is not motor able. Sometimes, school in one village caters to the needs of nearby villages as well. Education institutes or schools in nearby towns are usually overloaded and expensive and many of the parents cannot afford the cost of education for their children. Continuation of studies at home is marred by lack of electricity and consequently the children are engaged in different household activities. This becomes a vicious circle as lack of education leads to child labour further detoriating household income. In addition to the need of electricity energy for education, there is a growing need for electricity for irrigation purpose as well.

The supply to agriculture is limited to few fixed hours through out the day. Agriculture receives power mostly during off-peak hour as this reduces the cost of electricity supply for the transmission and distribution company. Because of the erratic nature of supply of electrical energy, the farmers have to be on their guard all the time. They have to immediately switch on their equipment after electricity supply resumes. Since the supply to agriculture is mostly during non-peak hour, the farmers are made...
to wait for the whole day for electricity supply to resume so that they can start their equipment for irrigation purposes. This results in reduction in productivity, wastage of labour, and equipment lying idle. Moreover, many a times the farmers would be engaged in one corner of the field where as the equipment would be installed at another place. It becomes imperative for a farmer either to be physically available at the equipment site or employ a labour only to switch on the equipment when electricity supply resumes.

2. Electricity Supply and Demand

Electricity is needed for irrigation purposes and there is an ever increasing need for the same. Many states have a huge gap in demand and supply of electrical energy. Table 1 shows energy shortages as published by India Core Publishing. The acute shortages of electricity and among others, farmers get affected (Murthy and Raju, 2009).

### Table 1. Energy Shortage (Source: Overview of power sector in India, 2005)

<table>
<thead>
<tr>
<th>Year</th>
<th>Demand (billion kWh)</th>
<th>Available (billion kWh)</th>
<th>Shortfall (billion kWh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990-91</td>
<td>267.632</td>
<td>246.560</td>
<td>21.072</td>
</tr>
<tr>
<td>1991-92</td>
<td>288.974</td>
<td>266.432</td>
<td>22.542</td>
</tr>
<tr>
<td>1992-93</td>
<td>305.266</td>
<td>279.824</td>
<td>25.442</td>
</tr>
<tr>
<td>1993-94</td>
<td>323.252</td>
<td>299.494</td>
<td>23.758</td>
</tr>
<tr>
<td>1994-95</td>
<td>352.260</td>
<td>327.281</td>
<td>24.979</td>
</tr>
<tr>
<td>1995-96</td>
<td>389.721</td>
<td>354.045</td>
<td>35.676</td>
</tr>
<tr>
<td>1996-97</td>
<td>413.490</td>
<td>365.900</td>
<td>47.590</td>
</tr>
<tr>
<td>2000-01</td>
<td>507.216</td>
<td>467.400</td>
<td>39.816</td>
</tr>
<tr>
<td>2003-04</td>
<td>559.264</td>
<td>519.398</td>
<td>39.866</td>
</tr>
</tbody>
</table>

Some measures are taken by different transmission and distribution companies, where they announce well in advance the availability of electricity hours in each month. This helps the farmers in planning their daily schedule of cultivation; as per the availability of electricity, they can plan to use pumps for pumping water to the fields. They can employ daily labours and schedule their work in such a manner that it will coincide with availability of electricity. However, there are still many roadblocks with this planning. During monsoon, flash flood, uprooting of trees, snapping of cables carrying electricity are common in many parts of the country. This disrupts electricity supply and makes any planning impossible. The supply is also disrupted because of bad quality of conductors leading to power outages. Transmission losses and pilferages also mean that farmers do not get their quota of power all the time. Because of such problems, availability of electricity is in short supply to farmers. Farmers can thus, operate the pumps for limited hours only when electricity is available to them.

Though there are many alternative energy sources are available, such as diesel generator, natural gas generators to pump water, the cost is too high for the farmers to afford. Due to draught, shortage of power, shortage of water, farmers are engaged in different works to earn money even though they depend mostly on agriculture for their livelihood. Agricultural statistics of India shows that over all agricultural population has gone down from 69% in 1994 to about 59% now (NSL Srivatsa, 2009). This is a concern seeing the present trend and future demand for the agricultural sector.

To summarize, the issues that the farmers face in India are myriad. There are issues at power generation, where there is a big gap between demand and supply of power. In addition to that there are political imperatives as well as social needs which determine the rationing of power supply for agricultural purposes. There are power outages as well as scheduled power cuts which affect farming;
because of unavailability of continuous power, farming equipment are not used to their fullest potential which leads to reduction in productivity. Off peak supply of power for agricultural purposes is done by transmission and distribution companies to reduce the cost of supply, but it also means that farmers have to forgo their social needs as well as any other fruitful revenue generation activities as they have to constantly be available in the fields as well as monitor the supply of power. Usually farmers’ houses are away from actual irrigation areas and when the supply of electricity is resumed, they have to walk to the water pump and switch on the pump. After switching it on, most of the times he has to wait near the pump so that he can switch off the pump after water pumping is finished or employ labours to switch off the pumps. The off peak power supply period is usually during night time, which means they have to spend sleepless nights to switch on and switch off the pumps. To make it worse, because of bad quality of conductors and poor repair and maintenance activities carried out by transmission and distribution companies, the quality of power supply is poor. Sometimes there low voltage power is supplied during these off peak period because of which it will not be possible to use the equipment; this implies that remaining vigilant to switch on the pump becomes a fruitless exercise.

3. Technology Solutions

The globalization has helped to increase awareness in terms of available opportunities and alternatives for farmers which would increase their family income. Using ICT, in Rajasthan, India, there have been success stories such as, e-mitra, e-chaupal, e-kiyosk. Eindia.net.in (2009), Different website has been dedicated to improving e-agriculture and is a harbinger in bringing revolution in Indian agriculture (www.agmarket.nic.in, http://agricoop.nic.in, http://seednet.gov.in). As per report available from USAID (2005), there has been an increase in annual income to the tune of $200-$400 for farmers in Maharastra, India. The opportunities lie in providing technological solution using improved electrical gadgets and equipment. However, these solutions make use of electrical equipment with improved technology that would demand availability of electricity to farmers. High yielding fertilizers, healthy seeds, plant protection methods using new electrical gadgets, however, will require supply of electricity to the agricultural area.

To improve operational efficiency of available electrical energy, measures have to be taken as a high priority. Farmers have to be educated on conservation of water and electrical energy. One of the suggestions by Murthy et al., 2009, is to design an intelligent system which helps in optimum utilization of electrical energy.

With the progress of mobile technology, the penetration of mobiles among villages and farmers has been high. The mobiles are affordable and have become a necessity in many households. Because of fierce price competition among mobile service providers, mobile telephony is becoming one of the cheapest in the world and helping rural India and helping rural India to get connected and thus facilitating people who are living even in isolated areas and difficult hilly terrains to get connected with the rest of the world. Mobile telephony is having a profound impact on rural India and improving quality of life of the farmers. Based on mobile technology, ICT solutions are now being thought of to provide cost effective working solutions to the day to day problems among farming community (www.mssrf.org, 2009).

The objective of this paper is to discuss a sustainable low cost mobile solution to farmers in India to tackle the issues related to conservation of energy and water as well as to address the unreliable and frequent power cuts which is affecting operational efficiency of farmers. The methodology adopted was through a field based real life case study.

Golite is in the business of developing agricultural products based in India, working with a range of technologies that are unique and state of the art. Based on the research and analysis, it has developed a product called “Raita Mitra” with an objective to help farmers by providing a solution using mobile technology to solve the irrigation problem which farmers are facing. “Raita Mitra” is a mobile based remote electric pump system which is controlled using using mobile SMS technology.

4. Overview of Wireless technology
Wireless tele-communications can be broadly categorized into two: mobile or cellular voice communications and fixed data communications. Mobile or cellular technology has changed the world of voice communication and it has connected billions of people across the world from urban to rural class. In India, mobile phones today have moved beyond their fundamental role of communications and have become another arm of their body. We are witnessing an era where users use mobile phones for not only talking to their beloved ones, but to also to read news headlines, surf the internet, keep a tab on astrology, and listen to music, make others listen to their music, or check their bank balance. With the entry of mobile technology to India, ordinary people like plumbers, carpenters, electricians, fruit vendors, petty store owners or farmers in remote villages have seen significant improvement in their business and life style because of their availability at anyplace, anytime, anywhere.

Short message service is a mechanism to deliver short, concise, text messages over the mobile networks. SMS is a store and forward way of transmitting messages from one mobile to another mobile. The message (text only) from the sending mobile is first sent to what is called short message center (SMSC), which stores the message and then forwards to the destination mobile. This means that in the case that the recipient is not available or out of range or switched off, the short message is stored and can be sent later. The "short" refers to the maximum size of the text messages which are 160 characters in length (letters, numbers or symbols in the Latin alphabet). These characters can be text (alphanumeric) or binary Non-Text Short messages. SMS also supports a return receipts services, means that the sender, can get a small message notifying if the short message was delivered to the intended recipient or not. SMS supports national and international roaming. This means that you can send short messages to any other GSM mobile user around the world. With the current generation wireless/mobile networks, all the three technologies, GSM, CDMA and TDMA support SMS.

5. Functional Overview of the Proposed Solution

Motor controls, such as ON/OFF are now controlled by “Raita Mitra” using the mobile SMS technology. “Raita Mitra” is directly connected to electric motor controls. Following diagram shows the operation of Raita Mitra.

Raita Mitra informs the farmer the availability of electric power through SMS. Once the farmer receives the message, he can decide to send an SMS message to the Raita Mitra unit, to start the electric motor using his mobile from anywhere. He need not have to be near the farm or field or even in his house. He can be anywhere outside tending to his various activities. Since this system works on mobile network, the farmer can receive messages wherever there is wireless network (roaming). Once the farmer sends an SMS to Raita Mitra, it decodes the message. Based on the message code, let us say 1, it will turn ON the motor and if the code is 2, will turn OFF the motor. Also, he can set a timer to turn off motor automatically for a predetermined time.

Some of the other useful messages sent by Raita Mitra are:

a. Power supply indication – sends a message indicating the availability of electric supply to motor

b. Low voltage indication – sends a message indicating voltage level or single phase supply to decide whether sufficient power voltage is available to turn on the motor

c. Water level indicator – sends a message indicating source water level to decide how long the water can be pumped

6. Stakeholders’ Benefits

The product, Raita Mitra, has been designed to make a farmer’s life easier. Using this, a farmer can do his water irrigation anytime, from anywhere without worrying about frequent power cuts, shortage of voltages, lack of water or the period of water that is required to be pumped. Following are some of the benefits a farmer can derive by installing this system:
a. Increased Productivity - Operations using SMS codes on wireless mobile network, a farmer can be potentially anywhere conducting other works, yet at the same time, be operating irrigation activity remotely.

b. Better Utilization of Electric Power – Motor operations (ON and OFF) are automatically controlled - when enough water is pumped, the motor is switched off automatically and hence saves power energy.

c. Avoidance of Wastage of Water – There is no wastage of water due to automation of Motor operations (ON and OFF).

d. Reduced Cost of Operation – Rata Mitra will not turn ON the motor unless the required voltage is available. Hence, operation of the pump set is more efficient due to less wear and tear of the motor and hence the whole irrigation operation turns out to be cost effective with a minimum investment.

Overall cost of irrigation and farming is reduced with higher degree of efficiency and increased productivity of farmers. Cost is saved by better utilization of time, money and resources. Since the whole operation of water irrigation is done through wireless technology, farmers can make use of their resources more productively. He can be anywhere, whether he is in a retail market selling goods, or bank paying his loan or other works, but still farming and irrigation can continue remotely by mobile. Figure 1 shows the working model of Raita Mitra.

For investors, the business model has shown good returns. Cash flow for first three yeas has been shown here which suggests that investors get benefited from this investment.

All figures are in INR (Indian Rupees)
Product:

Agricultural Products
- SMS Autostarter
- Auto Starters

Lighting Products
- Solar lamps
- Solar home lighting systems
- LED Torches

Cost of the Project: 50lacs (1 million USD)

1st year (Sep 2009 – Mar 2010):
Agricultural products  Estimated turnover  97.5 lacs
Lighting products  Estimated turnover  44.0 lacs

Total   1.41 crores (3.3 million USD)

Break even analysis
1st year:
1. Premises (Office + Industrial shed) rent : 0.85 lacs
2. Salaries : 11.00 lacs
3. Office expenses telephone : 0.70 lacs
KEB : 0.25 lacs
4. Stationary : 0.50 lacs
5. Marketing Expenses : 0.70 lacs
6. Misc : 0.70 lacs

Total : 13.70 lacs (31000 USD)

Profitability : Estimated net profit 20% = 28 lacs (63000 USD)

2nd year (April 2010 – Mar 2011):
Agricultural products  Estimated turnover  3.15 Cr
Lighting products  Estimated turnover  1.16 Cr

Total   4.3 crores (9 million USD)

Break even Analysis:
7. Premises (Office + Industrial shed) rent : 2.40 lacs
8. Salaries : 25.00 lacs
9. Office expenses telephone : 2.10 lacs
KEB : 0.75 lacs
10. Stationary : 1.50 lacs
11. Marketing Expenses : 2.10 lacs
12. Misc : 2.10 lcas

Total : 41.95 lacs (93300 USD)

Profitability : Estimated net profit 20% = 81.5 lacs (180000 USD)

3rd year (April 2011 – Mar 2012):
Agricultural products  Estimated turnover  3.8 Cr
Mobile Solution for Improving Operational Efficiency in Agricultural Sector
Prof. Umesh Hodeghatta Rao, Prof. Sanjay Mohapatra

Lighting products Estimated turnover 1.5 Cr

Total 5.3 crores (12 million USD)

13. Premises (Office + Industrial shed) rent : 2.80 lacs
14. Salaries : 32.00 lacs
15. Office expenses telephone : 2.40 lacs
KEB : 0.95 lacs
16. Stationary : 1.80 lacs
17. Marketing Expenses : 2.40 lacs
18. Misc : 2.40 lacs

Total : 44.75 lacs

Profitability : Estimated net profit 20% = 1.06 Cr (2.2 million USD)

Thus, investment breaks even by second year itself.

7. Conclusion

The mobile solution discussed here is an intelligent system which has been successfully deployed at more than 10 agricultural lands in Andra Pradesh, India. The solution gives the information about electric supply, water level and energy requirement on-demand. The mobile solution discussed in this paper will not solve electricity demand in the rural areas or the farmers’ inhibitions for irrigation but improves the operational efficiency of the farmer thus helps in improving economic output of the farmers. The solution discussed in this paper has been found to be sustainable and can be used in many parts of the country. The usage of technology has been demonstrated to be beneficial to all the stakeholders.

8. References

2. Srivastava N.S.L, “Farm Power Sources, their availability and future requirement to sustain agricultural power”, Document prepared by IASRI New Delhi as a part of a study Related to Formulating Long term Mechanisation Strategies of Each Agro-Climatic Zone/State, for the Department of Agriculture and Cooperation, Ministry of Agriculture, Govt. of India, pp 57-68, 2006.


